Some brief moments out of a 100 Years of a few selected strands of Operational Research in some areas of Health – UK (mostly England) 1948 – 2048 (though much of the past is skipped over and it’s all pretty vague about the future)

A practitioner’s perspective, and not a comprehensive review but it does draw on thirty years of personal experience, various shades of white and grey literature, and views recently sought from a range of prominent UK health analysts (for which grateful thanks)
Driven by concern with three underlying questions about the impact of OR in health

Yesterday

What have been areas of health or healthcare where OR analysts have had a significant impact? How have we achieved this?

Tomorrow

What are coming challenges for health or healthcare where OR analysts should seek to make a significant impact? How could we best contribute?

Today

What lessons should OR analysts working in health take from the past to help make a bigger impact in the future? What should we do today to prepare the path?
Itinerary and viewpoints

Part 1. Yesterday

Part 2. Tomorrow

Part 3. Today

Operational Research in Health UK 1948-2048

Penicillin 1940s

Polio victims in “iron lungs” 1950

Birth of the NHS 5 July 1948
Since 1948, expenditure, workforce and activity in the NHS has increased dramatically.
There have been many changes in the organisation, delivery and funding of care; even just in the last decade

**New structures**
- Strategic Health Authorities
- Primary Care Trusts
- Foundation Trusts

**New agencies**
- National Institute of Clinical Excellence
- National Patient Safety Agency
- Health Protection Agency

**New modes of patient engagement**
- Patient choice
- Patient advice and liaison services
- Self care support e.g. expert patients

**New fast access routes**
- NHS Direct
- Walk-in Centres
- Minor Injury Units

**New transactional processes**
- Payment by results
- Health and social service resource pooling

**New care settings**
- Treatment Centres
- Care closer to home
Many aspects of NHS care have hugely improved

Activity has increased, average waiting time has dropped

The war on waiting has had a major impact

Figure 1.3: Inpatient waiting times, England, 2000–04 (months waited)

Source: Chief Executive’s Report to the NHS (May 2004)
Though many challenges remain e.g. in variations and inequalities in treatment and access.

There are many deviations from clinical best practice

Variations in appropriate prescribing identified by medical literature reviews...

- Lipid lowering agents
- ACE inhibitors
- Beta-blockers
- Aspirin

Range of GPs correctly prescribing for cardiovascular disease

The middle class have a louder ‘voice’ than the less well off, and often get a better deal

- Intervention rates of Coronary Artery Bypass Grafts (CABG) or angiography following heart attack were 30% lower in lowest socio-economic group than the highest.

- Hip replacements 20% lower among lower socio-economic groups despite 30% higher need.

- A one point move down a seven point deprivation scale resulted in GPs spending 3.4% less time per consultation

There have been some significant measures to improve public health.

There has been a dramatic decline in smoking.

Vaccination has almost eliminated several childhood infectious diseases such as polio.

The last case of natural polio infection in the UK was in 1982.

Prevalence of smoking cigarettes amongst adults aged 16 and over, by age and gender

The health of the UK population has improved

Mortality from the major killers has fallen

Life expectancy is improving

Source: Office for National Statistics / Government Actuaries Department (GAD)
Although significant inequalities in health status persist.

Life expectancy varies considerably across the country.

Poverty and poor health tend to go together.

Minority groups often have worse health.

Prevalence of mental disorders among children (UK 1999)

Gross weekly household income

Life expectancy varies considerably across the country.

Rate of Maternal deaths by ethnic groups - 2000-2002

Deaths Rate per 100,000 maternities

Red = lowest LE
Green = highest LE
Some UK milestones in health care and health care management 1948-2007

- **1948** NHS Created
- **1950** Smoking linked to cancer
- **1954** First kidney transplant
- **1959** Contraceptive pill
- **1961** TV advertising ban on tobacco
- **1962** First full hip replacement
- **1962** District General Hospitals developed
- **1965** Thalidomide disaster
- **1966** Abortion act
- **1968** First heart transplant
- **1968** First test tube baby
- **1968** DHSS formed
- **1968** General management introduced into NHS
- **1968** MRI scanning
- **1969** NHS and Community Care Act
- **1974** NHS take over ambulance service
- **1976** RAWP funding allocation formula
- **1976** First kidney transplant
- **1978** Breast screening programme
- **1980** Black report on health inequalities
- **1980** First test tube baby
- **1980** AIDS campaign
- **1982** Last UK polio case
- **1984** General management introduced into NHS
- **1986** AIDS campaign
- **1986** BSE
- **1988** MMR vaccine
- **1990** NHS and Community Care Act
- **1990** NHS and Community Care Act
- **1998** NHS Direct
- **1999** NICE
- **1998** Patient choice pilots
- **1998** Breast screening programme
- **1999** RAWP funding allocation formula
- **2000** NHS waiting times targets
- **2000** NHS Walk In
- **2001** Report on Bristol cardiac surgery
- **2001** RAWP funding allocation formula
- **2003** Tobacco Advertising banned
- **2004** Patient choice pilots
- **2007** National smoking ban
- **2007** National smoking ban
- **2007** National smoking ban

Source: www.nhshistory.net
Meantime OR in the UK developed

April 1948
OR Club inaugurated

1955-75
OR expands in the UK into nationalised industries, civil government and the corporate sector

1975-2005
OR adapts to changing economy – shrinks in industry but expands in the service and government sectors

1950
OR Quarterly published

1978
JORS published

Government OR Service staff 1987-2005
Explicit UK health OR applications date from the early 1950s

1952

OPERATIONAL RESEARCH IN MEDICINE

by NORMAN T. J. BAILEY

A great deal of medical research is directly aimed at improving some specific aspect of curative or preventive medicine such as the development of a more powerful chemotherapeutic agent, a new serum giving greater protection against some infectious disease, a new surgical technique, more accurate and reliable methods of diagnosis, and so on. The activities involved may range all the way from biochemical or physiological laboratory experiments, or on abstract mathematical analysis of the behaviour of an epidemic, to controlled clinical trials in hospital wards and out-patient departments, or the complex ecological study of the whole environment of an associated disease. The research worker concerned may either be relatively isolated individuals working more or less independently of each other, or they may be organized into teams of researchers, including doctors, medical workers, surgeons, statisticians, and so on.

None of the pursuits broadly outlined in the previous paragraph qualifies as operational research in its own right, although it may be part of such a programme. Operational research in medicine is concerned with the organization of existing clinical techniques and facilities so as to make them more widely available to patients in need, with the replanning of wards, clinics and practices so as to employ present resources to the greatest advantage, and with general administration and planning of medical services. All the disciplines of scientific research in general and medical research in particular can be made to serve these ends.

The initial stages of the transition from the investigation of narrowly circumscribed problems to the broader operational level are excellently illustrated by the recently published M.R.C. report: The application of scientific methods to industrial and service medicine (1951, H.M.S.O.). This report is essentially the proceedings of a conference held in March 1950, the subject of which was comprehensively defined by Dr. Hinsworth in his opening address: "As the solution of the problems that are raised both for the individual and for the group by the organization of human effort." Operational research of any kind (and the medical field is no exception) usually entails a considerable amount of survey work, especially of the type commonly encountered in socio-medical investigations. In order to ensure that such surveys are adequately designed at the beginning and are efficiently analyzed and reliably interpreted at the end, it is usually necessary to have competent statistical advice. At the same time there is much to be gained if the other investigators are at least acquainted with some of the statistical requirements, and are on their guard against the pitfalls associated

1957

OPERATIONAL RESEARCH IN HOSPITAL PLANNING AND DESIGN*

by NORMAN T. J. BAILEY

The various aspects of modern medicine are extremely diverse, involving pure science, applied science, technology, political and economic questions, as well as serious human problems of value and morals. In principle there are almost unlimited possibilities for advance in clinical knowledge. In practice, however, there is usually only a limited amount of medical skill, drugs, building accommodation or finance actually available. It is clear therefore that there should be plenty of scope for application of the special methods of operational research, the object being to extract the maximum amount of practical benefit for the community out of restricted resources.

Operational research techniques can probably be applied with advantage at nearly all points of the medical field, but I want to confine the present discussion to just one major area, that which concerns the planning and design of hospitals. Even with this restriction one is faced by a vast network of complex interrelated problems. I shall therefore try to outline an approach which seems to me to provide a basis for further work, and shall also deal with one or two special investigations in more detail by way of illustration.

It will be realized that since every hospital that is built involves an immense investment of capital, it is quite impossible to perform some huge statistical experiment in which alternative types of building appear as 'treatments' to be examined for significant differences. This is of course quite a familiar difficulty. You can, for example, normally fight a given war only once. Although classical experiments can be performed at lower levels of organization with, say, weapons, communications, or combat formations, the overall conduct of the enterprise can only be, at best; a rationally integrated whole. So it is with hospitals. Experimental trials can be run on the lay-out and staffing of wards, or the organization of an outpatient department, but the broad pattern of a whole hospital tends to be relatively inflexible, and it cannot be experimentally reproduced with a large number of variations.

We are, however, entitled to expect that if we approach the problem of hospital building in a broadly scientific spirit, it will be possible to get as much as possible of the methods of operational research to

1 Unit of Business, Oxford University.
There have been some significant contributions from UK OR in health over the years.

To take just one small but significant area – waiting in outpatient and A&E departments – there has been a constant stream of OR work since the 1950s right up to today.

- A study of queues and appointment systems in hospital outpatient departments, N T Bailey, J R Stat Soc, 1952
- Design of an appointments system, R R P Jackson OR Quarterly, 1964
- An application of queuing theory to a congestion problem in an outpatient clinic, T F Keller DJ Laughhunn Decision Sciences, 1973
- Investigating outpatient departments, R M O’Keefe JORS, 1985
- Queueing models for out-patient appointment systems, M Brahimi D J Worthington JORS, 1991
- Using queuing theory to analyse the Government’s 4h completion time target in A&E, L Mayhew D Smith Health Care Mgmt Scnce, 2008

DH OR guidance 1985
UK health OR practitioners have contributed on a worldwide front.

1971

1981

2005

2007
There are wide-ranging recent national UK applications of health OR

Examples from work of Department of Health OR analysts

Policies and strategies
- Setting targets for waiting times
- Creation of NHS Direct
- Strategic framework for supporting self care
- Blood safety and vCJD risk strategy
- Chlamydia screening strategy
- Emergency incident counter measures

Implementation and delivery
- Peak load capacity planning (hospitals, walk-in centres, NHS Direct)
- Reducing waiting times (elective care and emergency care)
- Introducing total booking systems
- Expenditure forecasts for services (children, mental health, patient safety)

Monitoring and evaluation
- Understanding NHS Deficits
- Developing performance ratings for hospitals
- Assessing the Expert Patient Programme
- Evaluating a “whole system” change programme
And many recent local UK applications

Examples from the special health issue of JORS, February 2005

- Forecasting costs of long term care at local authority level
- Assessing demand for nurses in intensive care units
- Planning regional oral surgery services across London
- Operational design of a NHS walk-in centre
- Design of an integrated musculo-skeletal service
- Involving public and patients in improving services
UK health OR has a good reputation amongst its professional peers

“Unique selling points of significant strength within the British OR agenda are soft OR and applications in healthcare”

EPSRC 2004 Review of Research Status of OR in the UK
The numbers and organisation of health OR analysts in England has had its ups and downs

Many academics in university groups working in health OR/MS since the 1950s and 1960s

The Department of Health (DHSS as was) set up an OR group in the early 1970s and had around fifteen OR analysts in the 1980s, and it now has over thirty

In the 1980’s as many as nine of the then fourteen NHS Regional Health Authorities had OR groups; but the RHAs were abolished in 1996 and their OR groups were lost

A national clinical OR unit (CORU) was established in 1983

A number of management consultancies have people with skills in health OR/MS, but often not explicitly badged as such

Availability of analysts in the Health Authorities in England (2003)*

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Supply</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR analysts</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Economists</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Statisticians</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>Other e.g Accountants</td>
<td>37</td>
<td>28</td>
</tr>
</tbody>
</table>

Figures are extrapolated from a sample survey of 9 out of 28 SHAs existing in 2003
UK health OR does not appear very visible to managers or clinicians

Large growth in publication of papers on health topics in OR/MS journals

<table>
<thead>
<tr>
<th>Year</th>
<th>Search using Google Scholar, July 2008</th>
<th>In all publications (search on OR + health)</th>
<th>In BMJ only (search on OR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>114</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>126</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>146</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>681</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>1260</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>1720</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

But not of OR papers in the literature that managers and clinicians read

And many fashionable management approaches do not recognise their debt to OR

Six Sigma, Lean Thinking, Theory of Constraints, System and process mapping
# Other disciplines have higher visibility

<table>
<thead>
<tr>
<th>Search of 2007 publications for:</th>
<th>All publications (search on discipline + health)</th>
<th>BMJ (search on discipline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR and health</td>
<td>1.7k</td>
<td>9</td>
</tr>
<tr>
<td>Health Services Research</td>
<td>7.7k</td>
<td>105</td>
</tr>
<tr>
<td>Economics and health</td>
<td>48k</td>
<td>183</td>
</tr>
<tr>
<td>Statistics and health</td>
<td>68k</td>
<td>966</td>
</tr>
</tbody>
</table>

Searched with Google Scholar in July 2008
Although other disciplines share concerns about perceptions and use

Health Services Research generally is often not highly regarded by managers

- “Researchers are frustrated that their work is not used more widely”
- “NHS managers see little of relevance in the research available to them and see health services research as poor value for money”
- “Policy makers are concerned about the timeliness of research”

* P. Dash et al, Increasing the impact of health services research, BMJ, 2003, 327, 1339-1341
There are also – quite possibly related - issues about lack of implementation of modelling work.

1981 review of 200 simulation projects in health care found only 16 (8%) reported successful implementation.

JCT Wilson, Implementation of computer simulation projects in health care
JORS, 32, 825-832, 1981

2004 review found 182 papers on simulation in health (1980-99) but only a few reported on implementation so their “value could not be assessed”.

Fone D et al, Systematic review of the use and value of computer simulation modelling in population health and health care delivery
However, OR has contributed to a number of milestones in UK health care policy and management.

- **1948**: NHS Created
- **1962**: District General Hospitals developed
- **1968**: DHSS General management introduced into NHS
- **1974**: NHS take over ambulance service
- **1976**: RAWP funding allocation formula
- **1983**: Breast screening programme
- **1988**: OR analysts involved in evaluating choice regimes
- **1990**: NHS and Community Care Act
- **1998**: NHS Direct
- **2000**: NHS waiting times targets
- **2001**: Report on Bristol cardiac surgery
- **2004**: Patient choice pilots
- **2000**: NHS Walk in Centres
- **2001**: NHS and Community Care Act

**ORCON response time standards – updated version still in use today**

**OR analysts work on systems design e.g. balance of care**

**OR modelling framed new formula in 1988 with novel combination of modelling and empiricism**

**OR analysts carried out scenario work and proposed the establishment of this service**

**OR analysts modelling work on screening is influential**

**OR modelling has long underpinned these**

And that is without looking at major OR contributions in public health arena e.g. pandemics!
Part 2: Tomorrow: 2009-2048
Health care is a likely major growth area

The proportion of UK GDP spent on healthcare has steadily risen

And is this rise is expected to continue

The Wanless report estimated that in fifteen years time between 10.5% and 13% of GDP would be required to fund the UK health system.
NHS reform will continue, aiming at improving quality, choice, diversity, and efficiency

**Transaction Reform**
- Money following the patients, rewarding the best and most efficient providers, giving others the incentive to improve

**Demand-Side Reform**
- More choice and a much stronger voice for patients

**Supply-Side Reform**
- More diverse providers, with more freedom to innovate and improve services

**System Management and Regulation**
- A framework of system management, regulation and decision making which guarantees safety and quality, fairness, equity and value for money

**Results**
- Better health
- Better care
- Better value
More care should be safely and cost-effectively delivered “upstream” - in or closer to home

Technology can support integrated care at home

Dramatic improvements in home care are being achieved with technological support

- Hospital cost reductions per patient from £21,000 to £7,000 per annum (Telecare pilot UK)
- £3,000 saving per emergency admission in England (CFH)
Better chronic disease management should bring major gains

‘Our Health, Our Care, Our Say’ strengthened approach to long term conditions

- Much stronger support for **self-care**, through personalised information and local peer groups
- **Universal case management** for those with greater need
- Requirement for **multi-disciplinary teams** across health and social care
- **GPs held accountable** for the care of their registered population

**Predicting likely future use at individual level is becoming easier**

**Risk factors/diagnosis**

- **High**
  - Active recall and review
- **Medium**
  - “Routine plus”
- **Low**
  - Routine check-ups only

**Inverting the traditional pyramid of care by supporting self care and co-production**

20th Century Health Care?

- Individual self care
- Support of family and friends
- Support of community networks
  - Professionals as supporters
  - Professionals as partners
  - Professionals as authority

21st Century Health Care?

- High % of professional care
- Complex cases with co-morbidities
- Equally shared care
- High risk cases
- High % of self care
- 80-90% of cases
Better health promotion and prevention could produce a real primary care-led NHS

Current Preventative and Public Health Care Spend is relatively low

Key “Choosing Health” allocations
Action on diet, activity & obesity  £34 million
NHS Stop Smoking Services  £5 million
Alcohol interventions  £15 million

‘Choosing Health’ and ‘OHOCOS’ white papers re-prioritised public health and prevention

- Reduce the numbers who smoke
- Tackle obesity – with a focus on children
- Increase physical activity – more opportunities
- Support sensible drinking
- Improve sexual health
- Improve mental health and well being
- NHS Life Check targeted @ key life stages
- Health & social care working together
- Better information, more support for self care
- Tackle health inequalities
There remains much scope for improvement in efficiency and productivity

Huge variations in activity exist:

- Internationally: e.g. the UK does twice as many surgical procedures as in Spain.
- At the local level: e.g. activity levels of endoscopy operations can vary by as much as 800% (on stomach & intestine, 2003/04) by primary care trust.
- A significant fraction of A&E presentations and emergency admissions are unnecessary

There is wide variation in length of hospital stay:

- Varies enormously across 72 large acute trusts –driven by discharge rounds, adverse events, hospital acquired infection, etc…Up to £2bn direct cost of additional bed days

There is wide variation in use of day case surgery:

- Healthcare Commission calculate at least 74,000 operations could be moved to day surgery
Improvements need to be supported by modern IT and good financial management

### National Programme for IT

- The ultimate goal is better integration of electronic patient records, e-prescribing, and electronic appointment scheduling with an underlying principle of patient choice.
- To truly realise productivity gains, this IT investment will need to be accompanied by profound service transformation – learn from Wal-Mart or Ryanair.

### Financial Management

- Solid financial forecasting coupled with effective budget-setting and monitoring procedures.
- Trusts need to ensure their own financial systems are collecting the correct and accurate financial data in a timely fashion.
Change will not be problem free!

The changes threaten the traditional acute hospital

- Working Time Directive
- Specialisation
- New technology

- Shorter hospital stays
- Cheaper technology
- More anticipatory care
- More drug treatments
- Near-patient testing
- Expert patients
Looking further ahead, there are many possible health futures.
We need to watch for trends and for discontinuities

**Health Trends:**
- Ageing population
- Obesity
- Telecare

**Health Discontinuities:**
- AIDS
- Viagra
- Avian Flu
But our uncertainty about the future increases with time

There are only a few entirely robust forecasting methods*

"Prediction is very difficult, especially if it's about the future."
(Heinrich Heine)

"The future isn't what it used to be"
(Anonymous)

*illustration thanks to Philip Hadridge
Although the track record is not too bad

### BT’s 1997 crystal ball for healthcare

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
</table>
| 2000 | Artificial blood  
Full medical records stored on smart cards |
| 2005 | Personal wearable health monitors  
Determination of whole human DNA base sequence |
| 2010 | Artificial heart  
Robots extensively used for routine hospital tasks |
| 2015 | Genetic links to all diseases identified  
Individual’s genome is part of medical record  
Artificial lungs and kidneys |
| 2020 | Artificial liver  
Extension of average human life span to 100 years |

Source: BT Technology Calendar 1997 - 2045

Achieved 2001

22m health smart cards in Taiwan in 2002
We need to scan a range of major external factors influencing future health and care.
Their combined effect on the health and care system is likely to be profound.
An ageing population will put increasing pressure on NHS care

The ageing of the baby boomers will ramp up the numbers of older people

The ratio of the working age population to 65+ age group is set to drop rapidly

There will be zoomers and zimmers – and some who are both

People with long term conditions already account for about 70% of total health & social care spend. We may have 2 million more people with Long Term Conditions (LTCs) by 2020

Source: Government Actuary Department

Source: Department of Health

Source: Wanless Report
Our lifestyles are offsetting the gains made in public and personal health care.

Obesity is projected to rise - though smoking shows trends can be shifted.

- There are already more obese than normal weight adult males, by 2050 60% of men and 50% of women are forecast to be obese.
- Similar trends can be seen with drinking; however, smoking is set to decline, albeit with a hardcore of remaining smokers.

These lifestyle factors are having a very significant impact on the incidence of disease.

Forecast BMI in adult males aged 21 to 60, 1993 to 2050.

Estimated impact of the increasing trend in obesity by 2023 (% change).

The public will expect far more from public services, tailored to their individual needs.

**Consumer expectations now apply to public services**

**Areas of public services that need improvement**

- Keeping me informed on the services they provide
- Making it easy to get in touch when you have an enquiry
- Quickly responding to an enquiry
- Being able to contact them at weekends and in the evening

**People will look for “soft “ factors - a more personal and sensitive approach to care**

- Access & waiting
- Safe, high quality care
- Better information, more choice
- Clean, comfortable, friendly place to be
- Building relationships

**The overall “utility” or satisfaction indicator that a patient gives the service received**

- Patient experience - 40%
- Medical treatment & outcome
- Other factors - 10%
- Patient/locational factors (age/sex health status)
- Non-medical factors

**Around 50% of patient satisfaction with hospital treatment is related to non-medical factors**

Source: Marion Nestle, NYU, Nutrition Action Healthletter, 2002; PMSU policy review of public services; Motivations, mindsets and the NHS-SHM research 2007; Understanding drivers of patient satisfaction DH 2005; What the citizen wants - Henley Centre 2007
Medical technology holds out the prospect of a new era in personalised care

Genomics is transforming the pharmaceutical industry

Trastuzumab (Herceptin) is the most well known drug to result from pharmacogenomic design. There has been extensive debate about its cost-effectiveness, affordability and the initial lack of NICE approval for its widespread use.

Robots and nanotechnology will play an increasing role in food and medicine.

Personal Robotics Market ($000s)

The medical robotics market is forecast to quadruple from $1.3bn in 2006 to $5.7bn in 2011

Nanotechnology could manipulate molecules of foods to modify taste and change the nutritional values.

However the Soil Association have already adopted a “no-nano” position on organic certification.
Information will become ever more accessible

People increasingly access health information from the internet

<table>
<thead>
<tr>
<th>Sources of health information</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor</td>
<td>73%</td>
</tr>
<tr>
<td>Internet/website</td>
<td>30%</td>
</tr>
<tr>
<td>Leaflets or books</td>
<td>23%</td>
</tr>
<tr>
<td>Nurse/other health professional</td>
<td>22%</td>
</tr>
<tr>
<td>Family &amp; Friends</td>
<td>19%</td>
</tr>
<tr>
<td>Newspaper/ magazines</td>
<td>18%</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>6%</td>
</tr>
<tr>
<td>Patient organisations</td>
<td>4%</td>
</tr>
<tr>
<td>TV/Radio</td>
<td>4%</td>
</tr>
<tr>
<td>Advertisements</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>12%</td>
</tr>
</tbody>
</table>

- For most patients the first and most trusted source of information is their doctor, however faith in doctors’ expertise if beginning to erode –especially the younger patients (MORI 2001)

- In USA, many patients with chronic disease have rated their online support group as a more important resource than their health professional for many aspects of their health care.

Ubiquitous connectivity will promote remote monitoring of conditions

- Wireless sensors will allow diagnostic information to be monitored continuously from a distance by health professionals with a patient being almost unaware

- However, this raises confidentiality issues since there is also a risk that such data could be hacked into by other wireless devices

Source: Usage and Attitude survey DH; Mori; Technorati, April 2007
The workforce is likely to become increasingly diverse

Driven by demographics the workforce will age and depend more on women and immigrants

This will impact the health and care workforce

- Females now constitute 40% of GPs, and 60% of medical students. This will mean a greater requirement for part-time working and more flexible hours
- Similarly the NHS is already disproportionately dependent on staff from overseas (14% of the workforce vs 8% of UK population), and it is likely that this will continue
- Retaining older healthcare workers will also be crucial

The health and care workforce could also increasingly draw on the 3rd sector
Climate change is expected to increasingly impact on health and care. World food supplies are also emerging as a key issue.

The impacts effects of climate change on health and care could be significant

- Climate change, if it is not halted, will lead to more extremes of weather that will impact on health and care
- For instance, hot weather will cause problems for COPD patients, and flooding could lead to public health outbreaks

Source: IPCC Global Climate Predictions 4th Report; DTI Foresight; Maplecroft, 2007; Prof John Beddington Guardian 7th March

Food crisis will take hold before climate change

- It has been predicted that price rises in staples such as rice, maize and wheat would continue because of increased demand caused by population growth and increasing wealth in developing nations.
- The biofuel industry, has delivered a "major shock" to world food prices. Wheat prices in the UK have doubled in 12 months. Biofuel production is due to increase hugely in the next 15 years.
Emerging diseases can come from abroad, but the UK is also susceptible to home grown diseases.

Global travel is forecast to continue rising, easing spread of infections - & health tourism.

But the density of humans and wildlife make the UK too a global hotspot for emerging infectious diseases.

Map of world's Emerging Infectious Diseases hotspots

- **INFECTION DISEASES TRANSMISSIBLE BETWEEN ANIMALS & HUMANS**

  - Higher levels
  - Middle levels
  - Lower levels
How will OR meet these future challenges of change?

**Changes – e.g.**

- Aging ‘Baby Boomer’ Generation
- Rising expectations
- Changing lifestyles

**Challenges – e.g.**

- Ensuring provision for older people is more joined up – hospital and social care working together
- Changing services to allow care to be tailored to individual needs - more choice and responsiveness
- Promoting healthy lifestyles - shifting care upstream from treatment to prevention
We do have a significant contribution to offer - e.g.

**Challenges**

- Hospital and community services working together
- Greater choice and responsiveness
- Shifting care upstream from treatment to prevention

**OR Contribution (e.g.)**

- Helping understand and manage the interface between health and social care
- Helping to set, implement and monitor standards for customer service
- Exploring balance and timing of impact for treatment and prevention options

**Analytical Tools (e.g.)**

- "whole system" mapping and modelling
- Waiting time and capacity modelling
- System dynamics modelling, decision analysis
An effective response will depend on generic factors too - we should remember wise words from the past

Some of Blackett’s principles for effective OR

Collaborative “An OR section should be an integral part of a command and should work in the closest collaboration with the various departments at the command”

Grounded “All members of an OR section should spend part of their time at operational stations in close touch with the personnel actually on the job”

Pathfinding “An OR section which contents itself with the routine production of statistical reports and narratives will be of very limited value”

Three of Tomlinson’s six principles for effective OR

Catholic – OR should not be hide bound in techniques but should be wide ranging in the problems it addresses and the methods it is prepared to use

Balanced – the programme of the OR group should be balanced between long and short projects, tactical and strategic work and between old and new work

Catalytic – OR is an agent of change within the organisation

P M S Blackett Scientists at the Operational level, 1941 in “Advancement of Science vol 5 1948

RC Tomlinson, Presidential Address to OR Society in 1974 (see JORS 1998, 49, 403-407)
It’s not rocket science!

Technical advance is important but this is not the crucial challenge facing OR in health – or most other areas - today

<table>
<thead>
<tr>
<th>Factors affecting project success</th>
<th>Factors leading to project failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management support/involvement</td>
<td>Too technical/abstract approach</td>
</tr>
<tr>
<td>Verifiable and useful results</td>
<td>Customer not sold on the project</td>
</tr>
<tr>
<td>Well organised/communicated/presented</td>
<td>Poor communication</td>
</tr>
<tr>
<td>Economic benefits/business results</td>
<td>Poor problem definition/planning</td>
</tr>
<tr>
<td>Understanding true spirit of request</td>
<td>Lack of professional competence</td>
</tr>
<tr>
<td>User support/involvement</td>
<td>Over budget, not timely</td>
</tr>
<tr>
<td>Timeliness</td>
<td></td>
</tr>
</tbody>
</table>

OR Practice: survey results and reflections of practising INFORMS members

L Abdel-Malek¹, C Wolf², F Johnson² and T Spencer III²
There are many possible futures for health OR—depending on its impact and its visibility

- Glitter without gold
- High recognition
- Bright star
- Low recognition
- Decline and fall
- High impact
- Future?
- Now?
- Secret Service
What do we need to do *today* so health OR is equipped to make a strong contribution *tomorrow*?

**Key investment areas for UK health OR**

1. **Identify and focus on the key emerging challenges** for the UK health and care system at local, national and global levels

2. **Equip ourselves to help tackle them** with the right skills, positioned in the right places

3. **Gain powerful champions** who own the problems and can embed solutions in their organisation

4. **Make success visible** to and recognised by our users

5. **Understand better what we need to do!**
Draw on our spectrum of methods to scan for and to assess challenges on the horizon

1. Identify and focus on the key emerging challenges

<table>
<thead>
<tr>
<th>GROUP</th>
<th>QUALITATIVE</th>
<th>QUANTITATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• brainstorming</td>
<td>• systems dynamics</td>
</tr>
<tr>
<td></td>
<td>• behavioural simulation</td>
<td>• discrete event simulation</td>
</tr>
<tr>
<td></td>
<td>• scenario analysis</td>
<td>• mathematical modelling</td>
</tr>
<tr>
<td></td>
<td>• soft systems</td>
<td>• statistical analysis</td>
</tr>
</tbody>
</table>

- **accepting uncertainty**
- **seeking certainty**

- brainstorming
- behavioural simulation
- scenario analysis
- soft systems
- systems dynamics
- discrete event simulation
- mathematical modelling
- statistical analysis
1. Identify and focus on the key emerging challenges

### Categories

<table>
<thead>
<tr>
<th>International Research in Health UK 1948-2048</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational Research in Health</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Emerging Challenges</th>
<th>Categories</th>
<th>Sponsors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Care Organisation of the Year</td>
<td>Bupa</td>
<td>sanofi aventis</td>
</tr>
<tr>
<td>Managing Long Term Care</td>
<td></td>
<td>system C</td>
</tr>
<tr>
<td>Improving Care with Technology</td>
<td></td>
<td>National Patient Safety Agency</td>
</tr>
<tr>
<td>Data Driven Service Improvement</td>
<td></td>
<td>National Institute for Health and Clinical Excellence</td>
</tr>
<tr>
<td>Patient Safety</td>
<td></td>
<td>Healthcare Commission</td>
</tr>
<tr>
<td>Reducing Health Inequalities</td>
<td></td>
<td>Department of Health</td>
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<tr>
<td>World Class Commissioning</td>
<td></td>
<td>National Social Marketing Centre</td>
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<tr>
<td>Mental Health Innovation</td>
<td></td>
<td>Institute for Innovation and Improvement</td>
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<tr>
<td>Acute Organisation of the Year</td>
<td>CHKS</td>
<td>BT</td>
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<tr>
<td>Acute &amp; Primary Care Innovation</td>
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<td></td>
</tr>
<tr>
<td>Workforce Development</td>
<td></td>
<td>Skills for Health</td>
</tr>
<tr>
<td>Improving Health with NICE guidance</td>
<td></td>
<td></td>
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<tr>
<td>Best Social Marketing Project</td>
<td></td>
<td>Sustainable Development Commission</td>
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<tr>
<td>Corporate Citizenship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improving Patient Access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Centred Care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Service Redesign</td>
<td></td>
<td></td>
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</tbody>
</table>
Operational Research in Health  UK 1948-2048

Build strength in key problem solving areas

Survey of DH OR Analysts, 2006

<table>
<thead>
<tr>
<th>Rank</th>
<th>TOP TEN</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spreadsheet modelling</td>
<td>4.83</td>
</tr>
<tr>
<td>2</td>
<td>Statistics (introductory)</td>
<td>4.54</td>
</tr>
<tr>
<td>3</td>
<td>Problem structuring</td>
<td>4.46</td>
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<tr>
<td>4</td>
<td>Consulting skills</td>
<td>4.25</td>
</tr>
<tr>
<td>5</td>
<td>Project management</td>
<td>4.17</td>
</tr>
<tr>
<td>6</td>
<td>Public sector applications</td>
<td>4.08</td>
</tr>
<tr>
<td>7</td>
<td>Forecasting</td>
<td>3.88</td>
</tr>
<tr>
<td>8</td>
<td>Risk analysis</td>
<td>3.79</td>
</tr>
<tr>
<td>9</td>
<td>Performance measurement</td>
<td>3.79</td>
</tr>
<tr>
<td>10</td>
<td>Systems dynamics modelling</td>
<td>3.75</td>
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</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>BOTTOM TEN</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heuristics</td>
<td>2.92</td>
</tr>
<tr>
<td>2</td>
<td>Mathematical programming</td>
<td>2.79</td>
</tr>
<tr>
<td>3</td>
<td>Game theory</td>
<td>2.63</td>
</tr>
<tr>
<td>4</td>
<td>Logistics</td>
<td>2.58</td>
</tr>
<tr>
<td>5</td>
<td>Accounting &amp; financial management</td>
<td>2.33</td>
</tr>
<tr>
<td>6</td>
<td>Expert systems</td>
<td>2.33</td>
</tr>
<tr>
<td>7</td>
<td>Data envelopment analysis</td>
<td>2.25</td>
</tr>
<tr>
<td>8</td>
<td>Marketing</td>
<td>2.08</td>
</tr>
<tr>
<td>9</td>
<td>Credit scoring &amp; data mining</td>
<td>2.04</td>
</tr>
<tr>
<td>10</td>
<td>Manufacturing management</td>
<td>1.79</td>
</tr>
</tbody>
</table>

Key to scores  1=low importance  5=high importance

2. Equip ourselves to help tackle the key challenges
Develop a networked presence at all levels to allow both tactical and strategic work

In a more devolved and decentralised care system OR needs a stronger grass roots presence

Availability of analysts in the Health Authorities in England (2003)*

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Supply</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR analysts</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Economists</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Statisticians</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>Other e.g.</td>
<td>37</td>
<td>28</td>
</tr>
<tr>
<td>Accountants</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“This, instead of sending the observations of able seamen to able mathematicians on land, the land would send able mathematicians to sea, it would signify much more to the improvement of navigation and to the safety of men’s lives and estates on that element.” — Sir Isaac Newton, 1694

While retaining a strong central presence

2. Equip ourselves to help tackle the key challenges
Focus on adding crucial value for key problem owners

1. Know the customer’s business
2. Focus on problem owners needs
3. Appreciate the customer’s environment
4. Offer something distinctive

3. Gain powerful champions
Offer something distinctive – e.g. OR as the science of better!

OR analysts’ value to any business depends on being able to help with a number of thorny problem areas:

- Understanding how systems work
- Clarifying complex and messy problems
- Coping with uncertainty and risk
- Creating, developing and appraising options for change

And working closely with customers in building solutions

OR as a promoter of evidence-based management

3. Gain powerful champions
Publish and publicise in the right way to the right audiences in the right places

<table>
<thead>
<tr>
<th>Search of 2007 publications for:</th>
<th>All publications (search on discipline + health)</th>
<th>BMJ (search on discipline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR and health</td>
<td>1.7k</td>
<td>9</td>
</tr>
<tr>
<td>Health Services Research</td>
<td>7.7k</td>
<td>105</td>
</tr>
<tr>
<td>Economics and health</td>
<td>48k</td>
<td>183</td>
</tr>
<tr>
<td>Statistics and health</td>
<td>68k</td>
<td>966</td>
</tr>
</tbody>
</table>

4. Make success visible to and recognised by our users

N.B. Making success visible requires successes!

1981 review of 200 simulation projects in health care found only 16 (8%) reported successful implementation

JCT Wilson, Implementation of computer simulation projects in health care
JORs, 32, 825-832, 1981

2004 review found 182 papers on simulation in health (1980-99) but only a few reported on implementation so their “value could not be assessed”.

Fone D et al, Systematic review of the use and value of computer simulation modelling in population health and health care delivery

A study of queues and appointment systems in hospital outpatient departments, N T Bailey, J R Stat Soc, 1952

Appointment systems in hospital outpatient departments J D Welch, N T Bailey, Lancet 1952
Look for simple but powerful messages that will stick in users’ minds

4. Make success visible to and recognised by our users

Hospital admission refusals rise exponentially with occupancy

NHS Direct staffing rises exponentially as approach response time target (and similar results for A&E waiting)

Analysis and modelling results on demand variation were distilled into two simple messages:

- you can’t run a hospital at 100% occupancy without turning people away
- you can’t achieve 100% performance targets without an unlimited budget
Continuously seek to learn about how to enhance our impact!

Hope MASHnet will be able to follow up its pilot survey on the three questions posed at the beginning of this talk:

5. Understand better what we need to do!

What have been areas of health or healthcare where OR analysts have had a significant impact? How have we achieved this?

What are coming challenges for health or healthcare where OR analysts should seek to make a significant impact? How could we best contribute?

What lessons should OR analysts working in health take from the past to help make a bigger impact in the future? What should we do today to prepare the path?
And finally, back to 1948 - and forward to 2012

A few weeks after the birth of the NHS, the summer of 1948 saw London hosting the Olympics, after a gap of 40 years.

After over 60 years, London hosts the Olympics again in 2012.
Will UK health OR go for gold in the analysts’ hurdle race?

Available?

Visible?

Relevant?

Affordable?

Comprehensible?

Convincing?

Practical?

Timely?
Let’s not wait until 2048!

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